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When participatory workspace design meets engineering design in collaborative events

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Abstract. The Danish Workspace Design research program has developed and tested a new concept for ergonomists to intervene in design processes. In the case of an industrial manufacturer two sets of workshops were applied. The first set was based on a layout design game. The second set was use scenarios in which the future work processes and ergonomics were simulated. These workshops succeeded in reframing the engineering design project to include ergonomics and work processes. A layout game board, documents with schematic representations and a production manager turned out to be appropriate transmitters of insights and results from the workshops.

Keywords. Participatory ergonomics; Workspace design; Use scenarios; Engineering design.

1. Introduction

Many ergonomists are placed in consultative positions like the occupational health service (OHS) in Denmark. When dealing with technological change processes in client enterprises it is often a question for the OHS consultant to get access and influence the design process from an ergonomic point of view. In a previous study it has been shown that the ability to behave as a 'political reflective navigator' might be a success factor in such cases (Broberg & Hermund 2004). However, in stead of 'pushing' ergonomics into the design process the ergonomists could take another role. The role as 'workspace designer' might be a new approach for integrating ergonomics into workplace design processes. In this role the ergonomist takes a more design oriented approach with focus on staging the workspace design process.

The Danish Workspace Design (WSD) research program is aimed to develop and test a potential new concept for ergonomists and occupational health service (OHS) consultants to engage in design processes which implies new or changed workplaces. The notion of workspace design is inspired by the work of Horgen et al. (1999). The workplace with work practices is seen as embedded in the four dimensions: spatial, organizational, financial, and technological (SOFT). These dimensions are interdependent and in a

dynamic relationship with one another. A change in one may demands change in others. Staging the workspace design process is aimed at creating a dynamic coherence between work and these four dimensions of the workspace. Creating and shaping of workplaces is influenced by the actors who populate each of the four corners. The basic idea in the concept of workspace design is that actors are needed, who are capable of working across the four corners, facilitating and negotiating the process of workplace-making with the different actors. These actors are staging the workspace design process, they are workspace designers. This is a job of creating shared visions among actors with different perspectives and competencies, overcoming resistance and political interests, setting up a collaborative design process, and facilitates meetings between actors from different corners in the SOFT model.

Additionally, it is a core feature of the workspace design concept that staging the process is based on user participation. This implicates that methodologies and tools for user participation are an important element in the concept. And finally, the concept is aimed at helping organizations creating effective as well as sound workplaces meaning healthy and safe work conditions and good ergonomics.

2. The industrial manufacturer case

The test of the Workspace Design (WSD) concept took place in three case companies. This paper is reporting an analysis of the industrial manufacturer case in which a company was to implement a new mixing technology in their production line. The WSD project team included researchers and an OHS consultant from the OHS unit normally serving the case company. This team tried to take the role as workspace designer in relation to the technological change process which included implementation of a new process technology for mixing coating components and the lay out of a new plant. At the time of the WSD intervention the new mixing machine was specified and ordered. The supplier was in the process of building the machine in his own workshop. Two consulting engineers were involved by the industrial manufacturer to design and construct the new mixing plant.

The intervention by the WSD team was organized in two collaborative events each consisting of two workshops. The workshops had duration of approximately three hours. The events were design games which aimed at staging the meeting between the production management, two consulting design engineers and three employees of the mixing plant. The design game format was aimed at facilitating a collaborative design process between these actors. In the first event the workshops were focusing on the layout of the new plant in which the new mixing machine was to be installed. In the second event the two workshops were organized as use scenarios aiming at simulating work processes and ergonomics in the new plant.

The research questions based on this case study were: 1) What does WSD workshops contribute to the engineering design process? 2) How are insights and ideas from workshops “remembered” and sustained in the ongoing engineering design process taking place in the organization?

3. The layout design game

The first event was a layout design game which took place in a meeting room in the company. The WSD team had produced a game board and gaming pieces. During the two workshops, the participants were sitting around this game board placed in the middle at the table. The game board was a sketch of the floor plan of the existing mixing plant and the adjacent hall in which the new mixing machine were to be placed. Coloured cardboard pieces represented different artefacts in the plant. A WSD team member were game master and instructed the participants that the purpose of the design game was to set up a collaborative design process on the layout of the new mixing plant. He also stressed that the workshop was a sort of a 'laboratory' in which participants had the opportunity to explore different layout possibilities.

In short, the outcome of the layout design game was a proposal for the layout of the new mixing plant which were quite different from the two proposals originally made by the two consulting design engineers. Especially the work practice experiences and ideas brought in by the employees had a profound influence on the new proposal for layout including aspects of ergonomics. The employees were able to highlight things which not had been considered by the design engineers. The physical product of the layout design game was the game board with a floor plan at which the cardboard pieces illustrating the machine and other artefacts were placed in new ways.

4. The use scenario workshops

In the second collaborative event a use scenario was set up by the WSD team. The idea was to explore more closely the ergonomics and future work practice with the new mixing machine in the surroundings designed in the layout workshops. This was done by simulating future work processes through scenarios taking place in the empty hall designated for the new mixing plant. The WSD team produced two artefacts to facilitate the use scenario. The first thing was a 1:20 scale model of the new plant with movable representations of machines and devices, The second thing was the placement of tape markers on the floor representing the machines and new walls in the empty hall. The scale model was placed on a table in the empty hall and the use scenarios started out by having the participants standing around the model. At the same time it was possible to move around in the new mixing plant by looking at the tape markers on the flooring. Two different sort of use scenario were applied by the WSD team. In both cases the participants were production management, the two consulting design engineers, and three employees from the mixing plant. A WSD team member was game master.

4.1 Use scenario with incident cards

At the first use scenario the production manager and the employees were asked by the WSD game master to go through what would be expected to be a normal production scenario with the new machine. In doing that they were pointing in the scale model. Then the WSD team had prepared incident card where realistic production events were described. These events had been identified by interviews with employees and production management and based on experiences from the existing mixing plant. An example is the following text: "You have started the weekly cleaning process. Suddenly you spot a leaky

valve. Approximately five liters has spilled out on the floor and it is still leaking. It smells like an organic solvent. What do you do?". The idea was to open up for a collaborative investigation of how actual production events could be handled in the new mixing plant with a machine based on new principles. The employees took turn taking a card and together the employees discussed how they would deal with this event in the new facility. The other participants joined the open reflection by answering questions or putting forward their points of view. WSD team members continuously registered the identified potential problems and ideas to solve them on flip charts. Afterwards the flip charts were systematized by the WSD team in a document and handed out to all participants. All items at the flip charts were placed in three categories: Hall layout, the technical system, and work procedures. Things to be further investigated were registered too and persons to be responsible were appointed.

4.2 Use scenario on workplace assessment

The second use scenario took place in the same settings as the first one and with the same participants. Now the work environment and ergonomics in the new mixing plant were to be investigated with the aim of achieving a high degree of prevention. The workshop was staged by the WSD team by the following scenario: "The new plant now has been running for two years and today the OHS consultant comes for a visit to carry out a workplace assessment". A workplace assessment is a systematic mapping of the work environment and measures and is mandatory according to Danish law.

The OHS consultant was then taken on a tour of the new plant by the employees. This was done by moving around the tape markings at the floor and looking at the 3 D scale model. During the tour the OHS consultant asked a lot of specific questions on work procedures, workplace design, equipment and personal protections. All participants reflected openly upon these questions, and potential problems and ideas for solutions were registered by the WSD team and afterwards systematized in a document and handed out. This time the items were categorized by rooms in the new mixing plant, e.g. the control room, the mixing room, the chemicals storage room.

5. Use scenario contributions

The use scenarios explored the new production system as a result of the design process in the layout game workshops. The set up of the scenarios was a mixture of two main media for simulation according to Daniellou (2006): Experimental simulation based on a prototype and a narrative simulation where participants build up an oral account of feasible ways of carrying out the future tasks.

The use scenario with incidence cards proved to be a collaborative exploration of the characteristics of the new production system. Playing the scenarios revealed the difference between the employees' tasks and their conduct (Daniellou 2005). The employees were not talking and reflecting about their formal tasks. They were talking about the difficulties they could foresee in the new production system and were thinking loud about how to deal with these problems. By reflecting on the feasibility of conduct a lot of factors were identified which the design engineers and the production manager had not considered in the design of

the new system. There was even an 'on-the-spot' design decision by the production manager on moving a vacuum tank from a designated placement in the new mixing plant to a placement in the hall of the existing mixing plant. Further, the production manager revised the requirements specification document based on results from the workshops.

By the use scenario the WSD team facilitated the meeting between production managers, design engineers and the operators from the mixing facility. The scale model and the mark up of the floor were operating as appropriate 'boundary objects' (Wenger 2000) allowing connections between different work practices. Hence, the game board and the pieces enabled multiple practices to initiate a collaborative design process over an artefact which could be comprehended and interpreted by all participants.

The layout design games and later on the use scenarios became a reframing of the design object in the engineering design process. Bringing in the work practices of the operators and their reflections on conduct in the new system enlarged the design object to include redesign of the new production facility, work procedures, equipment, cleaning, maintenance and a number of work environment features. This contrasted to the original work of the design engineers which primarily focused on piping and layout of the technical components.

6. Transmitter devices between workshops and engineering design process

The workshops themselves contributed to set up a temporary learning space in which the daily power relations, expert roles and decision-making processes receded. In that way they enabled activities focusing on a collaborative design process and a mutual learning process. It was important, however, that the outcomes of the workshops were transmitted to daily life in the organization in order to enter into the engineering design process. It turned out that artefacts like the layout game board and systematic listings in documents served as important 'transmitter substance' and the project manager himself an important 'transmitter actor'. These artefacts contributed to sustain the insights and ideas from the workshops in a transparent way for all participants. By revising the requirement specification document part of the outcomes were also preserved in ordinary organizational documents.

The layout game board became a sort of an 'inscription device' (Latour 1987). The game board transformed the layout experiments and collaborative design among the participants into a figure or drawing. This figure was placed in the company and it was referred to after the workshops as the design of the new mixing plant. In this way it also had the role of transmitting results from the temporary workshops into the daily life of decision-making in the organization. The game board was a collaborative design product. It was a way of sustaining what at the end of the workshop was a shared understanding of the layout of the new mixing plant.

The inscription devices from the use scenarios were text in documents. It was however a transformation of the bullet points which had been recorded on flip charts during the scenarios. This text was analyzed and categorized by the WSD team into text in a schematic representation. It was not a rich information source but it turned out that the format fitted well with the engineering way of working.

7. Conclusion

The industrial manufacturer case showed how the WSD concept might contribute to an engineering design process. The WSD team took the role as workspace designer and by the participatory workshops achieved a reframing of the design object. The design object changed from primarily focusing at piping and layout of the technical components to include work processes, procedures, and work environment factors. In the role as workspace designer it was important for the WSD team to make sure that the achievements in the workshops were transmitted to and sustained in the ordinary engineering design process. In this case it turned out that design artefacts like the layout game board and systematized listings of ideas and requirements from the use scenarios served as appropriate transmitter devices. Further, the alliance between the WSD team and the production manager was of great importance in sustaining and follow-up on the workshop results.

8. Acknowledgements

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9. References

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